

WHAT IS CLAIMED IS:

1. A light emitting device comprising an organic light emitting element comprising:
- an anode;
 - a cathode; and
 - an organic compound film sandwiched between the anode and the cathode,
- wherein the organic compound film comprises at least two compounds selected from the group consisting of:
- a hole injecting compound that receives holes from the anode;
 - a hole transporting compound that has a hole mobility that is larger than its electron mobility;
 - an electron transporting compound that has an electron mobility that is larger than its hole mobility;
 - an electron injecting compound that receives electrons from the cathode;
- and
- a blocking compound capable of stopping the movement of holes or electrons,
- wherein the two compounds selected are materials capable of undergoing vacuum evaporation,
- wherein the organic compound film comprises a region in which the two compounds are mixed, and
- wherein the electric current versus electric voltage property of the organic light emitting elements show a rectification property.

2. A light emitting device according to claim 1, wherein the two compounds are hosts, and a guest is added to the region.

3. A light emitting device according to claim 2, wherein the guest is a light emitting compound for emitting light.

4. A light emitting device comprising an organic light emitting element comprising:
an anode;
a cathode; and
an organic compound film sandwiched between the anode and the cathode,
wherein the organic compound film comprises a first organic compound capable of undergoing vacuum evaporation and a second organic compound capable of undergoing vacuum evaporation, and the second organic compound is different from the first organic compound,
wherein the organic compound film comprises a region in which the first organic compound and the second organic compound are mixed,
wherein the concentration of the first organic compound and the concentration of the second organic compound change within the region, and
wherein the electric current versus electric voltage property of the organic light emitting element show a rectification property.

5. A light emitting device comprising an organic light emitting element comprising:
an anode;
a cathode; and
an organic compound film sandwiched between the anode and the cathode,

wherein the organic compound film comprises a first organic compound capable of undergoing vacuum evaporation and a second organic compound capable of undergoing vacuum evaporation, and the second organic compound is different from the first organic compound,

wherein the organic compound film comprises a region in which the concentration of the first organic compound and the concentration of the second organic compound continuously change, and

wherein the electric current versus electric voltage property of the organic light emitting element show a rectification property.

6. A light emitting device according to claim 4,

wherein the first organic compound and the second organic compound have properties selected from the group consisting of:

a hole injecting property for receiving holes from the anode;

a hole transporting property in which hole mobility is larger than electron

mobility;

an electron transporting property in which electron mobility is larger than

hole mobility;

an electron injecting property for receiving electrons from the cathode;

a blocking property for stopping the movement of holes or electrons;

and

a light emitting property for emitting light, and

wherein the first organic compound and the second organic compound have different properties selected from said group.

7. A light emitting device according to claim 5,

wherein the first organic compound and the second organic compound have properties selected from the group consisting of:

a hole injecting property for receiving holes from the anode;

a hole transporting property in which hole mobility is larger than electron mobility;

an electron transporting property in which electron mobility is larger than hole mobility;

an electron injecting property for receiving electrons from the cathode;

a blocking property for stopping the movement of holes or electrons;

and

a light emitting property for emitting light, and

wherein the first organic compound and the second organic compound have different properties selected from said group.

8. A light emitting device according to claim 4,

wherein the first organic compound has a hole transporting property in which hole mobility is larger than electron mobility,

wherein the second organic compound has an electron transporting property in which electron mobility is larger than hole mobility, and

wherein the concentration of the second organic compound increases as the concentration of the first organic compound decreases, in a direction from the anode to the cathode.

10043812.011002

9. A light emitting device according to claim 5,

wherein the first organic compound has a hole transporting property in which hole mobility is larger than electron mobility,

wherein the second organic compound has an electron transporting property in which electron mobility is larger than hole mobility, and

wherein the concentration of the second organic compound increases as the concentration of the first organic compound decreases, in a direction from the anode to the cathode.

10. A light emitting device according to claim 4,

wherein the first organic compound has a hole transporting property in which hole mobility is larger than electron mobility,

wherein the second organic compound has a light emitting property for emitting light, and

wherein the concentration of the second organic compound increases as the concentration of the first organic compound decreases, in a direction from the anode to the cathode.

11. A light emitting device according to claim 5,

wherein the first organic compound has a hole transporting property in which hole mobility is larger than electron mobility,

wherein the second organic compound has a light emitting property for emitting light, and

wherein the concentration of the second organic compound increases as the concentration of the first organic compound decreases, in a direction from the anode to the cathode.

12. A light emitting device according to claim 4,

wherein the first organic compound has a light emitting property for emitting light,

wherein the second organic compound has an electron transporting property in which electron mobility is larger than hole mobility, and

wherein the concentration of the second organic compound increases as the concentration of the first organic compound decreases, in a direction from the anode to the cathode.

13. A light emitting device according to claim 5,

wherein the first organic compound has a light emitting property for emitting light,

wherein the second organic compound has an electron transporting property in which electron mobility is larger than hole mobility, and

wherein the concentration of the second organic compound increases as the concentration of the first organic compound decreases, in a direction from the anode to the cathode.

14. A light emitting device according to claim 4, wherein the first organic compound is an aromatic amine compound.

15. A light emitting device according to claim 5, wherein the first organic compound is an aromatic amine compound.

16. A light emitting device according to claim 4, wherein the first organic compound is one of 4,4'-bis[N-(3-methylphenyl)-N-phenyl-amino]-biphenyl, 4,4'-bis[N-(1-naphthyl)-N-phenyl-amino]-biphenyl, and 4,4',4''-tris[N-(3-methylphenyl)-N-phenyl-amino]-triphenylamine.

17. A light emitting device according to claim 5, wherein the first organic compound is one of 4,4'-bis[N-(3-methylphenyl)-N-phenyl-amino]-biphenyl, 4,4'-bis[N-(1-naphthyl)-N-phenyl-amino]-biphenyl, and 4,4',4''-tris[N-(3-methylphenyl)-N-phenyl-amino]-triphenylamine.

18. A light emitting device according to claim 4, wherein the second organic compound is one of a metal complex containing a quinoline skeleton, a metal complex containing a benzo-quinoline skeleton, an oxa-diazole derivative, a triazole derivative, and a phenanthroline derivative.

19. A light emitting device according to claim 5, wherein the second organic compound is one of a metal complex containing a quinoline skeleton, a metal complex containing a benzo-quinoline skeleton, an oxa-diazole derivative, a triazole derivative, and a phenanthroline derivative.

20. A light emitting device according to claim 4, wherein the second organic compound is one of tris(8-quinolinolate) aluminum, bis(10-hydroxybenzo[h]-quinolinolate) beryllium, 2-(4-biphenyl)-5-(4-tert-butylphenyl)-1,3,4-oxadiazole, 1,3-bis[5-(p-tert-butylphenyl)-1,3,4-oxadiazole

-2-ir] benzene, 3-(4-tert-butylphenyl)-4-phenyl-5-(4-biphenyl)-1,2,4-triazole. and 3-(4-tert-butylphenyl)-4-(4-ethylphenyl)-5-(4-biphenyl)-1,2,4-triazole.

21. A light emitting device according to claim 5, wherein the second organic compound is one of tris(8-quinolinolate) aluminum, bis(10-hydroxybenzo[h]-quinolate) beryllium, 2-(4-biphenyl)-5-(4-tert-butylphenyl)-1,3,4-oxadiazole, 1,3-bis[5-(p-tert-butylphenyl)-1,3,4-oxadiazole-2-ir] benzene, 3-(4-tert-butylphenyl)-4-phenyl-5-(4-biphenyl)-1,2,4-triazole, and 3-(4-tert-butylphenyl)-4-(4-ethylphenyl)-5-(4-biphenyl)-1,2,4-triazole.

22. A light emitting device according to claim 4,

wherein the organic compound film comprises a third organic compound which is capable of undergoing vacuum evaporation and which is different from the first organic compound and the second organic compound, and

wherein the third organic compound is included as a guest in the region.

23. A light emitting device according to claim 5,

wherein the organic compound film comprises a third organic compound which is capable of undergoing vacuum evaporation and which is different from the first organic compound and the second organic compound, and

wherein the third organic compound is included as a guest in the region.

24. A light emitting device according to claim 22,

wherein the first organic compound and the second organic compound organic compounds are selected from the group consisting of:

a hole injecting compound for receiving holes from the anode;
a hole transporting compound in which hole mobility is larger than electron mobility;
an electron transporting compound in which electron mobility is larger than hole mobility;
an electron injecting compound for receiving electrons from the cathode;
and
a blocking compound for stopping the movement of holes or electrons,
and
wherein the third organic compound is a light emitting organic compound for emitting light.

25. A light emitting device according to claim 23,

wherein the first organic compound and the second organic compound organic compounds are selected from the group consisting of:
a hole injecting compound for receiving holes from the anode;
a hole transporting compound in which hole mobility is larger than electron mobility;
an electron transporting compound in which electron mobility is larger than hole mobility;
an electron injecting compound for receiving electrons from the cathode;
and
a blocking compound for stopping the movement of holes or electrons,
and

wherein the third organic compound is a light emitting organic compound for emitting light.

26. A light emitting device according to claim 22, wherein the third organic compound is one of a metal complex containing a quinoline skeleton, a metal complex containing a benzoxazole skeleton, and a metal complex containing a benzo-thiazole skeleton.

27. A light emitting device according to claim 23, wherein the third organic compound is one of a metal complex containing a quinoline skeleton, a metal complex containing a benzoxazole skeleton, and a metal complex containing a benzo-thiazole skeleton.

28. A light emitting device according to claim 22, wherein the third organic compound is one of tris(8-quinolinolate) aluminum, tris(4-methyl-8-quinolinolate) aluminum, and bis(10-hydroxybenzo[h]-quinolinolate) beryllium.

29. A light emitting device according to claim 23, wherein the third organic compound is one of tris(8-quinolinolate) aluminum, tris(4-methyl-8-quinolinolate) aluminum, and bis(10-hydroxybenzo[h]-quinolinolate) beryllium.

30. A light emitting device according to claim 22, wherein the third organic compound is a light emitting compound which emits light from a triplet excitation state.

31. A light emitting device according to claim 23, wherein the third organic compound is a light emitting compound which emits light from a triplet excitation state.

32. A light emitting device according to claim 22, wherein the third organic compound is a metal complex comprising platinum as a central metal, or a metal complex comprising iridium as the central metal.

33. A light emitting device according to claim 23, wherein the third organic compound is a metal complex comprising platinum as a central metal, or a metal complex comprising iridium as the central metal.

34. A light emitting device according to claim 22, wherein the third organic compound is one of (2,3,7,8,12,13,17,18-octaethyl-21H-23H-porphyrin) platinum, tris(2-phenylpyridine) iridium, and tris(2-(4-methylphenyl)-pyridine) iridium.

35. A light emitting device according to claim 23, wherein the third organic compound is one of (2,3,7,8,12,13,17,18-octaethyl-21H-23H-porphyrin) platinum, tris(2-phenylpyridine) iridium, and tris(2-(4-methylphenyl)-pyridine) iridium.

36. A light emitting device according to claim 22, wherein the energy difference between the highest occupied molecular orbital and the lowest unoccupied molecular orbital of the third organic compound is larger than those of the first organic compound and the second organic compound.

37. A light emitting device according to claim 23, wherein the energy difference between the highest occupied molecular orbital and the lowest unoccupied molecular orbital of the third

organic compound is larger than those of the first organic compound and the second organic compound.

38. A light emitting device according to claim 22, wherein the third organic compound is one of phenanthroline derivative, a oxadiazole derivative, and a triazole derivative.

39. A light emitting device according to claim 23, wherein the third organic compound is one of phenanthroline derivative, a oxadiazole derivative, and a triazole derivative.

40. A light emitting device according to claim 22, wherein the third organic compound is one of vasocuproin, 2-(4-biphenyl)-5-(4-tert-butylphenyl)-1,3,4-oxadiazole, 1,3-bis[5-(p-tert-butylphenyl)-1,3,4-oxadiazole-2-yl] benzene, 3-(4-tert-butylphenyl)-4-phenyl-5-(4-biphenyl)-1,2,4-triazole, and 3-(4-tert-butylphenyl)-4-(4-ethylphenyl)-5-(4-biphenyl)-1,2,4-triazole.

41. A light emitting device according to claim 23, wherein the third organic compound is one of vasocuproin, 2-(4-biphenyl)-5-(4-tert-butylphenyl)-1,3,4-oxadiazole, 1,3-bis[5-(p-tert-butylphenyl)-1,3,4-oxadiazole-2-yl] benzene, 3-(4-tert-butylphenyl)-4-phenyl-5-(4-biphenyl)-1,2,4-triazole, and 3-(4-tert-butylphenyl)-4-(4-ethylphenyl)-5-(4-biphenyl)-1,2,4-triazole.

42. A light emitting device according to claim 4, wherein the detected amount of an element detected by SIMS changes continuously in a direction from the anode to the cathode in the region.
and

wherein the element is included in one of the first organic compound and the second organic compound.

43. Alight emitting device according to claim 5, wherein the detected amount of an element detected by SIMS changes continuously in a direction from the anode to the cathode in the region, and

wherein the element is included in one of the first organic compound and the second organic compound.

44. Alight emitting device according to claim 4,

wherein at least one of the first organic compound and the second organic compound comprises a metal complex comprising a metallic element, and

wherein the detected amount of the metallic element detected by SIMS changes continuously in a direction from the anode to the cathode in the region.

45. Alight emitting device according to claim 5,

wherein at least one of the first organic compound and the second organic compound comprises a metal complex comprising a metallic element, and

wherein the detected amount of the metallic element detected by SIMS changes continuously in a direction from the anode to the cathode in the region.

46. A light emitting device according to claim 44, wherein the metallic element is aluminum, zinc, or beryllium.

47. A light emitting device according to claim 45, wherein the metallic element is aluminum, zinc, or beryllium.

48. A light emitting device according to claim 22, wherein an element detected by SIMS is included in the region and the third organic compound comprises the element.

49. A light emitting device according to claim 23, wherein an element detected by SIMS is included in the region and the third organic compound comprises the element.

50. A light emitting device according to claim 22, wherein the third organic compound is a metal complex comprising a metallic element and the metallic element detected by SIMS is included in the region.

51. A light emitting device according to claim 23, wherein the third organic compound is a metal complex comprising a metallic element and the metallic element detected by SIMS is included in the region.

52. A light emitting device according to claim 50, wherein the metallic element is aluminum, zinc, or beryllium.

53. A light emitting device according to claim 51, wherein the metallic element is aluminum, zinc, or beryllium.

54. A light emitting device according to claim 50, wherein the metallic element is iridium or platinum.

55. A light emitting device according to claim 51, wherein the metallic element is iridium or platinum.

56. A method of manufacturing a light emitting device comprising an organic compound, comprising the steps of:

providing a substrate comprising an electrode;

making a vacuum chamber comprising at least first and second organic compound evaporation sources in a reduced pressure state by reducing the pressure within the vacuum chamber to be equal to or less than 10^{-3} Pa; and

performing evaporation of the first organic compound in the first organic compound evaporation source and a second organic compound contained in the second organic compound evaporation source on the substrate while a pump for reducing the pressure within the vacuum chamber is operated,

wherein each of the first and second organic compound evaporation sources comprises a container comprising an organic compound, and

wherein the second organic compound is evaporated next after the first organic compound is evaporated, under a state in which the first organic compound evaporation source is not heated and in which an atmosphere of the first organic compound remains within the vacuum chamber.

57. A method of manufacturing a light emitting device comprising an organic compound, comprising the steps of:

providing a substrate comprising a first electrode;

making a vacuum chamber comprising at least first and second organic compound evaporation sources in a reduced pressure state by reducing a pressure within the vacuum chamber to be equal to or less than 10^{-3} Pa;

performing evaporation of the first organic compound in the first organic compound evaporation source and a second organic compound contained in the second organic compound evaporation source on the substrate while a pump for reducing the pressure within the vacuum chamber is operated;

forming the second electrode by evaporation after the second organic compound is evaporated; and

performing a heat treatment in a pressure equal to or less than 10^{-4} Pa after the second electrode is formed,

wherein the vacuum chamber further comprises an electrode material evaporation source comprising a container comprising a material for a second electrode,

wherein each of the first and second organic compound evaporation sources comprises a container comprising an organic compound,

wherein the second organic compound is evaporated next after the first organic compound is evaporated, under a state in which the first organic compound evaporation source is not heated and in which an atmosphere of the first organic compound remains within the vacuum chamber.

58. A method of manufacturing a light emitting device comprising an organic compound, comprising the steps of:

providing a substrate comprising an electrode;

making a vacuum chamber comprising at least first and second organic compound evaporation sources in a reduced pressure state by reducing a first pressure within the vacuum chamber to be equal to or less than 10^{-3} Pa; and

performing evaporation of the first organic compound in the first organic compound evaporation source and a second organic compound contained in the second organic compound evaporation source on the substrate while a pump for reducing the pressure within the vacuum chamber is operated,

wherein each of the first and second organic compound evaporation sources comprises a container comprising an organic compound, and

wherein the second organic compound is evaporated next after the first organic compound is evaporated, under a state in which a second pressure within the vacuum chamber is higher than the reduced pressure state.

59. A method of manufacturing a light emitting device comprising an organic compound, comprising the steps of:

providing a substrate comprising a first electrode;

making a vacuum chamber comprising at least first and second organic compound evaporation sources in a reduced pressure state by reducing a first pressure within the vacuum chamber to be equal to or less than 10^{-3} Pa;

performing evaporation of the first organic compound in the first organic compound evaporation source and a second organic compound contained in the second organic compound evaporation source on the substrate while a pump for reducing the pressure within the vacuum chamber is operated;

forming the second electrode by evaporation after the second organic compound is evaporated; and

performing a heat treatment in a pressure equal to or less than 10^{-4} Pa after the second electrode is formed,

wherein the vacuum chamber further comprises an electrode material evaporation source comprising a container comprising a material for a second electrode,

wherein each of the first and second organic compound evaporation sources comprises a container comprising an organic compound,

wherein the second organic compound is evaporated next after the first organic compound is evaporated, under a state in which a second pressure within the vacuum chamber is higher than the reduced pressure state.